

**Running Like a Girl:
Athletics Performance of Women Whose Eligibility is Subject to
World Athletics DSD Regulations**

Sasha Gollish (Faculty of Kinesiology, University of Toronto), Shane M
Heffernan (Swansea University), Adam J Herbert (Research Centre for Life
and Sport Sciences, Birmingham City University), Madeline Pape
(University of Lausanne), Catherine M Sabiston (Faculty of Kinesiology,
University of Toronto), Georgina K Stebbings (Manchester Metropolitan
Institute of Sport, Manchester Metropolitan University, UK), Alun G
Williams (Manchester Metropolitan Institute of Sport, Manchester
Metropolitan University, UK), Roger Pielke Jr (University of Colorado
Boulder and American Enterprise Institute, corresponding author,
pielke@colorado.edu)

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Abstract

This paper compares four running events (100m, 200m, 400m, 800m) in
terms of (a) official in-competition career-best performances of nine women
with natural variations in their sex characteristics known to fall under the
World Athletics Eligibility Regulations for the Female Classification -
Athletes with Differences of Sex Development (DSD) with (b) the
distribution of all performances in those four events in the Paris 2024
Olympics for both men and women. The analysis shows that, despite not
having suppressed their testosterone as required to compete under the
regulations, none of these women perform like men and all their career-best
performances are well within the range of women's performances. Evidence
of in-competition performances of women whose eligibility is subject to the
World Athletics DSD regulations does not support the claim that regulation

As submitted

31 of these women is necessary to counter their “insuperable” performance
32 advantages over other women.

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36 **Introduction**

37 Although women's sport made its Olympic debut in 1904, it wasn't until the
38 Paris 2024 Olympic Games that numerical gender parity was achieved,
39 indicating progress towards equality for men's and women's sport.

40 However, the performance differences between elite women and men¹
41 across many sports and disciplines raise important questions about
42 eligibility and fairness, particularly in elite women's sport.

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44 During the 2024 Paris Olympics, two women boxers faced global scrutiny
45 and online abuse associated with their right to compete in the women's
46 category. Scrutinizing a woman athlete's sex, gender, and appearance is not
47 new,² with challenges over which women should be allowed to participate in
48 elite women's competition having been discussed and debated for almost a
49 century.³

50

51 World Athletics⁴ (WA, formerly known as the International Association of
52 Athletics Federations or IAAF – hereafter we use WA), the global governing
53 body that sets the rules and standards and organizes global championships,
54 formally introduced the women's category in 1928, which thereafter led to
55 debates over eligibility to compete in the women's category. In 1968 The
56 International Olympic Committee (IOC) introduced formal gender eligibility
57 screening for women athletes, resulting in more than three decades of
58 compulsory genetic screening for elite women athletes.⁵ Starting in 2009,
59 following the WA World Championships, WA implemented a series of rules
60 and regulations focused on women athletes' testosterone levels. WA has

1 ¹ Tucker and Santos-Concejero. *The Unlikelihood of an Imminent Sub-2-Hour Marathon:
2 Historical Trends of the Gender Gap in Running Events.*; Valérie Thibault *1 Women and men
3 in sport performance*; [LB Ransdell](#), CL Wells - *sex differences in athletic performance*

4 ² Sarah Teetzel. THE ONUS OF INCLUSIVITY: SPORT POLICIES AND THE
5 ENFORCEMENT OF THE WOMEN'S CATEGORY IN SPORT; Lena Holzer: What Does it
6 Mean to be a Woman in Sports? An Analysis of the Jurisprudence of the Court of Arbitration
7 for Sport; Bostwick and Joyner; Pielke 2016

8 ³ See, e.g., Pielke 2017

9 ⁴ <https://worldathletics.org/news/iaaf-news/iaaf-to-introduce-eligibility-rules-for-femal-1>

10 ⁵ *Gender verification of female athletes. Elsas et al.*

61 been criticized and celebrated for these DSD⁶ regulations, which continue
62 to be litigated in multiple legal forums. While sport has used both sex and
63 gender terms to describe sporting categories, WA describes the competition
64 categories as ‘men’s’ and women’s and this convention of ‘men’s’ and
65 ‘women’s’ is used throughout.⁷

66
67 In March 2023 WA issued the current version of gender eligibility
68 regulations - limiting the participation of certain women in the women’s
69 competition category. These women are referred to in the media, social
70 media, and literature as intersex athletes, athletes with Differences in
71 Sexual Development (DSD), or athletes with natural variations in their
72 biological development (natural variation). Depending on the reference
73 when referring to the women who fall under this regulation, when referring
74 to the WA regulations these women are referred by the name in the DSD
75 regulation, otherwise throughout this paper these women are identified as
76 having natural variations. While the updated 2023 gender eligibility
77 regulations separately cover transgender women, the focus of our analysis
78 is on the DSD regulations applying to women with certain variations in their
79 sex characteristics that result in naturally occurring testosterone levels. For
80 these women to compete in the women’s category they must demonstrate
81 that they have undergone medical intervention(s) by an approved WA
82 medical examiner to reduce their testosterone levels below 2.5 nmol/L for a
83 sustained period no less than 24 months.⁸ According to the World Medical
84 Association, such interventions for purposes of meeting the WA Regulations
85 are medically unnecessary, unethical, and therefore WMA recommends that

11 ⁶ The Regulation from World Athletics is called Eligibility Regulations for the Female
12 Classification - Athletes with Differences of Sex Development (DSD). DSD athletes were
13 previously miscategorized as hyper-androgenous athletes. DSD individuals have previously
14 also previously been called intersex. More recently, the International Olympic Committee
15 (IOC) published guidelines recommending ‘athletes with sex variations.’

16 ⁷: [https://worldathletics.org/competitions/world-athletics-championships/world-athletics-](https://worldathletics.org/competitions/world-athletics-championships/world-athletics-championships-budapest-2023-7138987)
17 [championships-budapest-2023-7138987](https://worldathletics.org/competitions/world-athletics-championships/world-athletics-championships-budapest-2023-7138987)

18 ⁸ [https://worldathletics.org/download/download?filename=2ffb8b1a-59e3-4cea-bb0c-](https://worldathletics.org/download/download?filename=2ffb8b1a-59e3-4cea-bb0c-5af8b690d089.pdf&urlslug=C3.6%20-%20Eligibility%20Regulations%20for%20the%20Female%20Classification%20-%20effective%2031%20March%202023)
19 [5af8b690d089.pdf&urlslug=C3.6%20-%20Eligibility%20Regulations%20for%20the](https://worldathletics.org/download/download?filename=2ffb8b1a-59e3-4cea-bb0c-5af8b690d089.pdf&urlslug=C3.6%20-%20Eligibility%20Regulations%20for%20the%20Female%20Classification%20-%20effective%2031%20March%202023)
20 [%20Female%20Classification%20-%20effective%2031%20March%202023](https://worldathletics.org/download/download?filename=2ffb8b1a-59e3-4cea-bb0c-5af8b690d089.pdf&urlslug=C3.6%20-%20Eligibility%20Regulations%20for%20the%20Female%20Classification%20-%20effective%2031%20March%202023)

medical professionals refuse to treat women athletes for purposes of meeting the criteria of the WA regulations.⁹

The women that are the focus of WA DSD regulations were each recorded as female at birth and have maintained that identity into adulthood. WA is clear in its regulations – if not in practice – that “[i]n no way are [the regulations] intended as any kind of judgement on or questioning of the sex or the gender identity of any athlete.”

WA explains that the regulations are necessary because women with certain natural variations have an unfair performance advantage compared to other women athletes. In a 2018 press release WA explained that such women have “a performance advantage of at least 5-6% over a female athlete with testosterone levels in the normal female range.”¹⁰ However, at that time there was no study (peer reviewed or in the grey literature) of what, if any, performance advantage women with certain biological variations may have over other women. Since that time no such study has been published.

In this paper we present the first empirical analysis of performances of women who have publicly stated that they fall under the WA DSD regulations in comparison to performances of other elite women.¹¹ While WA promised and continues to promise confidentiality under the DSD regulations, this is not practically possible and thus, has not occurred. Athlete medical data is not publicly available, and nor should it be, but there is a blurring in the confidentiality when these women are ‘medically examined’ and information is shared amongst WA staff and physicians.

Practically, this blur or breach in confidentiality happens due to the way

⁹ <https://www.wma.net/news-post/wma-urges-physicians-not-to-implement-iaaf-rules-on-classifying-women-athletes/#:~:text=At%20its%20Council%20meeting%20in,ethics%20and%20human%20rights%20standards>

¹⁰ <https://worldathletics.org/news/iaaf-news/iaaf-statement-cas-arbitration-of-new-female>

¹¹ WA promises full confidentiality for the athletes who fall under its regulations, which has not occurred and, practically, is not possible. Full medical information for these athletes is not public, and nor should it be.

anti-doping testing occurs, where these women are 'flagged' under the current anti-doping testing system.

The Central Question: Do women whose eligibility is regulated under the WA DSD regulations perform like men?

In 2019, middle distance runner Caster Semenya of South Africa challenged a previous version of the WA gender regulations at the Court of Arbitration for Sport (CAS).¹² CAS is an institution established under Swiss law to resolve sports-related disputes through arbitration and mediation, operating under its own procedural rules and recognized globally for its binding decisions on cases involving athletes, sports organizations, and governing bodies. The judgment of that case, which Semenya lost in a 2-1 panel vote, provides guidance on the scientific and empirical basis that underlies the WA rationale for the regulations and the panel's majority judgement.

The CAS panel summarized the WA (then IAAF) position as follows, referring here to 5-ARD (5 alpha-reductase), which is one of the conditions that falls under the regulations (emphases added):

- "[T]he IAAF contends that since 5-ARD athletes are "biologically identical" to male athletes (save with respect to virilisation of external genitals) they derive performance benefits from their physiology that are **indistinguishable from the advantages derived by male athletes.**" (Semenya 296)

¹² CAS 2018/0/5794 Mokgadi Caster Semenya v. International Association of Athletics Federations;

CAS 2018/0/5798 Athletics South Africa v. International Association of Athletics Federations. The Court of Arbitration for Sport (CAS) is an independent institution established to resolve sports-related disputes through arbitration and mediation, operating under its own procedural rules and recognized globally for its binding decisions on cases involving athletes, sports organizations, and governing bodies.

- "[T]he IAAF's position is that the evidence demonstrates that the performance advantage that 5-ARD athletes enjoy by virtue of their elevated endogenous testosterone is **the same as the performance advantage that the hormone confers on all male athletes.**" (Semenya 562)
- "The IAAF contends that, for sporting purposes, individuals with 5-ARD are **biologically indistinguishable from males** without a DSD and have been shown to dominate in sport over "biological females" who, the IAAF asserts, have **no chance to win** when competing against such "biologically male" athletes. This is because, it says, from a biological perspective 5-ARD athletes are **the same in every material respect** to male athletes without DSD." (Semenya 503)

One of WA (then IAAF) consultants testified at CAS that:

- "[I]f their [women with certain DSDs] androgen receptors function properly, they will have **exactly the same performance advantages** over female athletes as non-DSD males athletes have. On average, this advantage is between 10% and 12% in running events, while it may be as high as 20% in jumping events." (Semenya 353)

Two of the three arbitrators accepted the IAAF's arguments, writing in the majority judgment:

- "[T]he elevated testosterone levels that such athletes possess can create **an insuperable advantage** over other female athletes who do not have a 46,XY DSD condition" (Semenya 579)

This paper seeks to test the central proposition that is repeated explicitly in these arguments - specifically that the performance advantage of women with certain natural variations is the same as the performance advantage

possessed by men. Following from the claims cited above, evidence from performance in competition would be expected to show that the world's best elite women with naturally occurring variations that are covered by the WA DSD regulations would have performance results "indistinguishable" or "exactly the same" as men, and demonstrate an "insuperable advantage" over other women.

We test this hypothesis with in-competition performance results from nine athletes -- who by their public comments fall under the WA DSD regulations -- compared to all men's and women's performance results from the 2024 Paris Olympics.¹³ The performances used in the analysis to compare to the Paris results include results where none of these women with natural variations was under testosterone suppression or any other medical intervention to reduce their testosterone levels. The performances analyzed for the women with natural variations occurred before the previous and current WA DSD regulations. We find that, despite having *not* changed their testosterone levels to comply with the WA DSD regulations, these women have performances consistent with other elite women and inconsistent with elite men.

Data and Methods

Performance data for women who fall under WA DSD regulations and for Paris 2024 events come from the official competition statistics of WA.¹⁴ Each of the nine women in this study have WA official times for multiple distances. The distances included in the analysis are the 100m, 200m,

¹³ In no instance was any of these women under testosterone suppression or any other medical intervention to reduce their testosterone levels, as required under the WA DSD regulations. This logically makes sense because the times analyzed here occurred before the implementation of the WA DSD regulations rendered these nine women ineligible to compete.

¹⁴ <https://worldathletics.org/stats-zone>

195 400m, and 800m -- the primary events in which these women compete.¹⁵
196 There are very few recorded times for the 1500m, 5000m, and 10k, which
197 are not shown here, but with results that are consistent with the results
198 shown below. Because of the WA regulations, we assume that no athlete in
199 the 2024 Paris Olympics Athletics (Track and Field) competition was a
200 woman who fell under the WA DSD regulations, allowing for a comparative
201 analysis of performances of women who fall under the regulations with a
202 much larger pool of women who do not.¹⁶

203
204 For each distance we plot the performance difference of the top 100 official
205 times (or if less than 100, then as many as are available) recorded at the
206 Paris 2024 Olympics for men and women in relation to the fastest men's
207 time. For instance, in Figure 1, if one looks at the far left of the graph 1A to
208 compare the fastest woman and fastest man in the 100m you see an almost
209 10% difference, which means that the observed first women's time was
210 almost 10% greater (i.e., slower) than the fastest men's time. If we continue
211 in position (e.g., from first to tenth) we see both the women's and men's
212 times represented as a performance difference; what remains is a
213 performance difference between men and women. For instance, at the
214 hundredth position (the far right) in the 100m, the performance difference
215 between men and women is approximately 13%.

216
217 On these plots we overlay with green lines the career best times at each
218 distance for each woman falling under the DSD regulations (in contrast,
219 most performances by women competing at the Paris Olympic Games in the
220 100m-800m were not their career best performances). For instance, in the
221 same Figure for the 100m, the first green line is drawn at 12.1%; meaning
222 that the career best of the woman subject to WAS DSD regulations was

41 ¹⁵ There are only a few times for the 1500m, 5000m, and 10k, not shown here, but with
42 results that are consistent with the results shown below.

43 ¹⁶ We also assume that no athlete at the Paris 2024 Games was using performance-
44 enhancing substances, as all participants were subjected to uniform anti-doping
45 regulations.

12.1% slower than the fastest man at Paris 2024 and slower than all the men that competed in Paris. In addition, we also overlay in black the WA officially recognized women's world record time for each distance. In the same graph for the 100m, the women's world record is 7.2% slower than the fastest time recorded by a man at the Paris 2024 Olympics and slower than all the men that competed in this event.

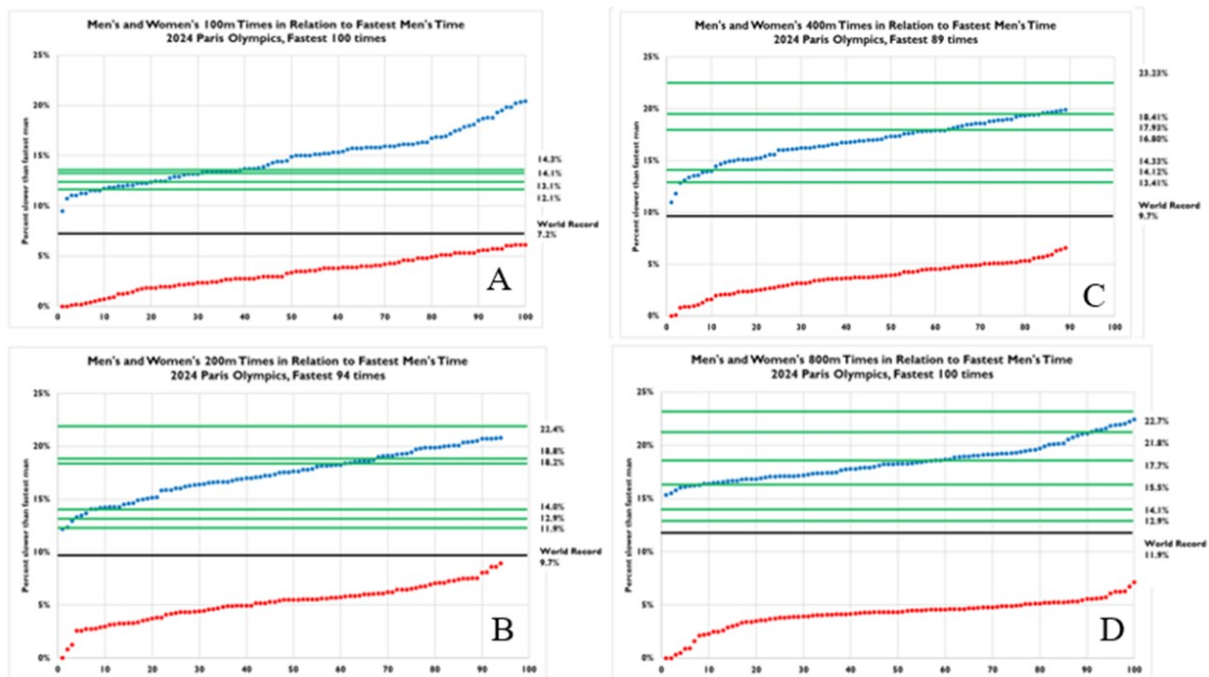
These plots allow for a simple and transparent assessment of whether the regulated athletes' performances are similar to those of men or represent an "insuperable" advantage over other women.

Results

The analysis, Figure 1, shows that the career bests of these nine athletes with natural variations fall entirely within the distribution of women's performances at Paris 2024, for the 100m, 200m, and 400m, and that all but two athletes fall within the distribution for the 800m¹⁷. This analysis would likely look different if the results compared the personal best of each of the athletes who competed in Paris, rather than on their performance during the games. Of particular note, is the 800m, which is often run tactically at a championship event compared to the 100m, 200m, and 400m run at full effort. Consequently, this analysis is very conservative in that it captures the career best of these 9 women compared to the results of a single Olympic Games. None of the identified women have a women's world record or threatened a world record. Similarly, none of these nine athletes have performances anywhere close to the distribution of men's performances at Paris 2024. In the 200m, 400m, and 800m there are an equal number of

¹⁷ We note that this graph would look different if it was based on the personal bests of each of the athletes who competed in Paris, rather than on their performances during the Games, particularly since the 800m at a championship is often run tactically, while the 100m, 200m, and 400m are typically run at full effort. Consequently, our analysis is very conservative in that it compares the career bests of the 9 women versus results from a single Olympic games.

regulated women in the top and bottom half of each distribution of Paris
2024 performances. In all events but the 100m, at least one of the regulated
women has never achieved even the minimum performance seen by a
woman athlete in Paris. Table 1 shows the performances displayed in the
figures.



255
256 **Figure 1.** Each panel shows performances at the Paris 2024 Olympics for
257 men (red) and women (blue) in relation to the fastest men's time, for the
258 100m (A), 200m (B), 400m (C), and 800m (D). The career best times for
259 women who fall under the 2023 DSD WA regulations are shown in green.
260 Also shown (in black) is the WA officially recognized world record women's
261 time for each distance. For the 400m and 800m there was one regulated
262 athlete at each distance whose time was >25% and thus do not appear on
263 the figures.

264

265

**Table 1: Career-Best Performances of 9 Women
whose Eligibility is Subject to WA DSD
Regulations and the Women's World Record in
Relation to Fastest Men's Performances at Paris
2024**

		Distances (m)			
		100	200	400	800
Women's World Record Time		7.2%	9.7%	9.7%	11.9 %
Fastest		12.1%	11.9	13.4	12.9
			%	%	%
		13.1%	12.9	14.1	14.1
			%	%	%
		14.1%	14.0	14.3	15.5
			%	%	%
		14.3%	18.2	16.8	17.7
			%	%	%
Slowest			18.8	17.9	21.8
			%	%	%
			22.4	18.4	22.7
			%	%	%
			27.5	23.2	37.2
			%	%	%
				28.0	
				%	

Note: Some women
have times in
multiple events.

266

267 Three women who medaled in past Olympics would have medaled in Paris
268 2024 had they managed to repeat their career best performances in the
269 200m and 800m. None of the other six women would have medaled in any

event at Paris 2024, despite performances in these events being considerably slower than world record paces. Like all the women who competed at Paris 2024, none of the regulated women met the men's standard. Of note, the gold medalist in the women's 800m in Paris won with a time that was more than 2 seconds (~1.7%) slower than her personal best, which could lead to an overestimation of the career-best performances of women subject to the DSD regulations when compared to those not affected by the regulations.¹⁸

Even after accounting for the difference in population sizes of typical men (~50% of a population) and women with relevant variations, one might expect the world's best women athletes subject to WA's 2023 DSD Regulations to perform at least as well as the world's 1,000th fastest men. However, the world's 1,000th fastest men's times in 100m (10.2s), 200m (20.5s), 400m (45.5s) and 800m (1min 49.9s) are all much faster than the current women's world records,¹⁹ and even further below (faster) the world's best women subject to WA's 2023 DSD regulations.

Discussion

In the 2019 Semenya CAS arbitration, WA sought to reclassify the women who they sought to regulate as "biological males":

"the DSD Regulations are "an extremely progressive and fair compromise" between, on the one hand, the right of female athletes to compete separately from men so that they have the same opportunity

¹⁸ Similarly, the 800m (and all longer running events) is an event that is often run tactically at championships games, compared to the 100m, 200m, and 400m, which are typically run at full effort from start to finish, ensuring that times at championship meets are closer to personal best performances. This means that the times for the women subjected to the DSD regulations look much faster than the winning time at Paris. If we compare the fastest time (1:54.25) run by a woman subjected to these regulations compared to the fastest time (1:54.61) run by the winner at the Paris 2024 Olympics.

¹⁹ <https://worldathletics.org/stats-zone>

to excel, and, on the other hand, the desire of "certain biologically male athletes with female gender identities" to compete in the female category of competition." (Semenya 285)²⁰

One reason why WA may have chosen to focus on identity, rather than performance, is that at the time, there was no evidence showing that women with natural variations in their sex-linked characteristics held an "insuperable" or "exactly the same" performance advantage over other women than men have over women.²¹ Despite seeking to implement various versions of the regulations since 2011, neither WA nor any independent researchers have quantified the competitive performances of the women who fall under the WA DSD regulations versus other women or men.

Indeed, this acclaim is made in a recent statement on differences in athletic performance between women and men, led by WA's Medical and Scientific Director: that women with natural variations in their sex characteristics are simply "biological male." A focus on reclassifying these women as men renders such performance data irrelevant, because it has been established (and is also clear from the analysis above) that there is a performance gap between women and men at the elite, high-performance level of many sports and events. WA has misidentified these women – all of whom were recorded female at birth and maintained that identity into adulthood – as "biological males." Then, based on the mis-identification, WA compares data of men's and women's performances to justify their DSD regulation.

²⁰ In public, the IAAF denied this when the media reported that they were seeking to reclassify these women "biologically male" -- "The IAAF has not said that DSD athletes should be classified as male. That is what Caster Semenya's lawyers say our case is, because they think that will help them before the Court of Arbitration for Sport, but that is not our case," said IAAF lead counsel Jonathan Taylor.

<https://www.theguardian.com/sport/2019/feb/13/caster-semenya-iaaf-report>

²¹ Tucker and Santos-Concejero. *The Unlikeliness of an Imminent Sub-2-Hour Marathon: Historical Trends of the Gender Gap in Running Events*; Valérie Thibault *1 Women and men in sport performance*; LB Ransdell, CL Wells - *sex differences in athletic performance*

In contrast, the CAS Semenya judgment concluded explicitly that the regulations must focus on what, if any, performance advantage the women subject to regulation may have over other women, and not an individual's identity. The Panel explained that it:

“ . . . does not consider it necessary specifically to determine whether the IAAF's invocation of the concept of a "male sport sex" possessed by "biological males" and a "female sport sex" possessed by "biological females" is valid and/or proper. Instead, the Panel considers it appropriate to focus on whether women with 46 XY DSD such as 5-ARD have an athletic advantage over other female athletes and, if so, whether the magnitude of that advantage is capable of subverting fair competition in certain athletic events.”

With the focus on performance advantage, WA uses overall men's performance data to suggest that women with certain natural variations have performances akin to men:

“These advantages (which translate, in athletics, to an average 10-12% performance difference across all disciplines) make competition between men and women as meaningless and unfair as an adult competing against a child or a heavyweight boxer competing against a flyweight. Only men would qualify for elite-level competition; the best female athlete would not come close to qualifying.”²²

The judgment of the 2015 Chand CAS arbitration with WA (then IAAF) argued similarly that evidence of performance advantage would be necessary to justify regulation, and that the magnitude of any advantage

²² <https://worldathletics.org/news/iaaf-news/iaaf-statement-cas-arbitration-of-new-female>

matters in the context of the necessity to regulate the participation of a subset of women:

“[T]here is presently insufficient evidence about the degree of the advantage that androgen-sensitive hyperandrogenic females enjoy over non-hyperandrogenic females. In the Panel's opinion this is significant. It is not self-evident that a female athlete with a level of testosterone above 10 nmol/L would enjoy the competitive advantage of a male athlete, which performance advantage would be, on the IAAF's evidence, in the order of 10-12% (the approximate difference, on the evidence of the IAAF, between men and women and, therefore, an unfair advantage), rather than, say, 1% (a relatively marginal advantage, having regard to the many other variables that contribute to athletic performance).”²³ (Chand, 522)

WA has at various times asserted that the women subject to its DSD regulations enjoy a 10-12% advantage over other women, a 5-6% advantage, a 3% advantage, and a 1.6% advantage.²⁴ What these claims share is a lack of evidentiary basis.

In 2018 WA (then IAAF) published a paper seeking to quantify the advantages of higher testosterone levels in elite women, and that analysis was found to have been riddled by errors,²⁵ requiring a major correction several years later: “To be explicit, there is no confirmatory evidence for causality in the observed relationships reported. . . With this in mind, we recognise that statements in the paper could have been misleading by implying a causal inference.”²⁶

²³ CAS 2014/A/3759 Dutee Chand v. Athletics Federation of India (AFI) & The International Association of Athletics Federations (IAAF)

²⁴ See Chand, Semenya, and <https://worldathletics.org/news/iaaf-news/iaaf-statement-cas-arbitration-of-new-female>

²⁵ <https://link.springer.com/article/10.1007/s40318-019-00143-w>

²⁶ <https://bjsm.bmj.com/content/55/17/e7>

376

377 A comparison of career best times of the nine athletes versus the results
378 from a single event at a single Olympics, arguably with moderate times,
379 biases the analysis in favor of accentuating the performances of the nine
380 athletes in relation to other women. Even with this bias, it is undeniable
381 that the performances of the women who fall under the WA DSD regulations
382 is consistent with that of other women, and inconsistent with the
383 performances of men.

384

385 Specifically, the analysis in this paper shows that the women who currently
386 fall under the 2023 WA regulations run like other women, with
387 performances that span a wide range of the distribution of women's
388 performances in Paris 2024. The claims of WA and conclusions of the
389 Semenya CAS panel are thus simply not supported by the available
390 evidence.

391

392 During the Semenya 2019 CAS arbitration, WA asserted that coaches were
393 seeking out women athletes with naturally occurring sex variations, as
394 observed by one of the authors.²⁷ If that is true, then we should have some
395 confidence that the elite women included in this study are the fastest
396 women subject to WA's 2023 DSD regulations. On the other hand, to show
397 that women with natural variations in their sex characteristics perform like
398 elite men would require only one case. No such case has ever occurred in
399 the history of athletics dating back over a century.

400

401 Even if it was demonstrated that women with certain variations do have
402 some degree of advantage over other women without those characteristics,
403 it would need to be proven that the advantage gained is greater than that
404 associated with the many other factors that influence performance,
405 including among women. It would not be unique in elite sport where many

77 ²⁷ Personal observation

rare or unique biological and physiological conditions have been identified that confer some degree of advantage. As Bostwick and Joyner (2012) argue, “genetic advantages could be considered the norm in world-class competitive sports.”²⁸ Cerit et al. (2020) review a range of known genetic traits that confer athletic advantage and conclude, “There are so many factors that affect athletic performance that even if one competitor is considered superior to another, the result is almost always doubtful. It is clear that ideal genes probably push an athlete to greatness, but that these ideal genes also do not guarantee an optimal result.”²⁹

Sport scientist Ross Tucker explains this in the context of whether decorated swimmer Michael Phelps had a unique body type giving him an unfair advantage over other male swimmers (emphasis in original):

“Now, one could have a debate over whether we *SHOULD* think about creating a category for small feet or short arms. If we did this, then [Michael] Phelps' supposed advantages would become 'outside of category', and we'd say that he's not allowed to swim in the protected category, right? But we don't need to do this, because the advantages that he [Phelps] has are tiny compared to what male advantage does to performance. Phelps wins by 0.5%. Males win by 12% (compared to females). By scale, then, these advantages are orders of magnitude different. . . The only way around this is to say that we should create a category because Advantage X is so large it also overwhelms the result. But it doesn't - as mentioned, by scale, what Phelps has over males is tiny compared to what males have over females.”³⁰

²⁸ Bostwick, J. M., & Joyner, M. J. (2012, June). The limits of acceptable biological variation in elite athletes: should sex ambiguity be treated differently from other advantageous genetic traits? In *Mayo Clinic Proceedings* (Vol. 87, No. 6, pp. 508-513). Elsevier.

²⁹ Cerit, M., Dalip, M., & Yildirim, D. S. (2020). Genetics and athletic performance. *Research in Physical Education, Sport & Health*, 9(2).

³⁰ <https://x.com/Scienceofsport/status/1820462042765001041>

The most successful woman who falls under the 2023 WA regulations is South Africa's Caster Semenya. At the London 2012 Olympics, Semenya's margin of victory over the fourth place finisher – the first one off the podium – was 0.6% and in Rio 2016, the difference between her Gold and fourth place was 1.5%, which is not unusual in an 800m performance. As shown in Figure 1D neither gap was remotely close to the ~15% gap between men and women 800m athletes at Paris 2024. In fact, the overall gap between men and women in Paris in the 800m is an order of magnitude larger than Semenya's greatest victory.

Contrary to these views and evidence, Handelsman (2024) suggests that “any systematic (dis)advantage of even 1% can be considered unfair against individual or identifiable groups of competitors.” Were that true, then, for example at Paris 2024, in the same events (the women's 100m to the 400m), all the event winners have an advantage over the individual who finished in 4th; in the 800m the advantage is just less than 1% over 4th, but over 1% at the 5th position. The range of times among the top 100 men and women in the 100m (Figure 1) respectively reached 106.1% and 111.3% (Figure 1A) of the fastest time (200m = 108.9% and 109.1% Figure 1B, 400m = 106.6% and 109.8% Figure 1C, 800m = 107.1% and 107.7%, Figure 1D). Thus, as a practical matter performance differences across these four events -- within both men's and women's events -- among competitors of 6-11% are judged to allow for fair and meaningful competition in Athletics (Track and Field). Performance differences between men and women in these four events are larger than 6-9%, with no overlap in the distributions (Figure 1).

Conclusion

As the CAS has repeatedly found, the performance capabilities of women subject to WA DSD Regulations cannot be assumed from their chromosome status or androgen levels; data necessary to assess any unfair advantage

464 should come from actual performances. The evidence provided in this paper
465 shows that the women excluded by WA's DSD regulations do not, as a group
466 or as individuals, have "insuperable" performance advantages over other
467 elite women, nor are their performances in any way comparable to those of
468 elite men. These women's performances are entirely consistent with those
469 of other women.

470
471 Put differently, whatever advantages accrue to such women because of their
472 naturally occurring variations that fall under the WA DSD regulations,
473 competition data clearly indicates that they are no more consequential than
474 the many other factors -- biological and social -- that shape elite
475 performances in the women's category. This study specifically examines
476 women in athletics, yet the findings underscore broader implications across
477 all sports, suggesting that women with naturally occurring variations should
478 be evaluated based on their actual competitive performance capabilities
479 rather than their biology.

480
481 In short, evidence in performance shows no "insuperable" advantage.
482 Rather, in the absence of such evidence, these women are excluded based
483 on their biological characteristics. Efforts to redefine these women as men
484 will not change the evidence of performances showing that these women do
485 indeed run like girls.